Re-examination of Temperatures Referred to in the Thermal Conductivity and Thermal Diffusivity Data Measured by the Transient Hot-Wire Method

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Two temperatures referred to in the thermal conductivity and thermal diffusivity data, measured with the transient hot-wire technique, are re-examined. The temperature T_λ assigned for the thermal conductivity is derived as follows:

$$T_\lambda=T_B+\Delta\theta_\lambda=T_B+\{(\chi+\phi)/\chi\}\Delta T_m,\quad \Delta T_m=(1/2)\{\Delta T(t_i)+\Delta T(t_f)\} \tag{1}$$

to be somewhat revised from the temperature $T_m=T_B+\Delta T_m$ used hitherto.
Then, the temperature T_κ for the thermal diffusivity is newly introduced as follows:

$$\begin{aligned} &T_\kappa=T_B+\Delta\theta_\kappa,\\ &\Delta\theta_\kappa=(1/2)\{(\chi+\phi)/(\chi-\phi)\}\{(Q_0/4\pi\lambda_0)^{-1}\Delta T_m{}^2\\ &\qquad -(1/4)(Q_0/4\pi\lambda_0)(\ln t_f/ t_i)^2\}+(Q_0/4\pi\lambda_0)\ln 4, \end{aligned} \tag{2}$$

which differs from the initial temperature (i.e., the bath temperature T_B) conventionally used hitherto. Where, χ and ϕ are the temperature dependence of the thermal conductivity and thermal diffusivity, and subscripts ($_i$) and ($_f$) mean initial and final. The study is applied to the measurement of *n*-Heptane, *n*-Pentane, and iso-Pentane, and the validity is confirmed.